

What is claimed is:

1. A system for diagnostically evaluating the health of tissue within the fundus of an eye, which comprises:

5 a laser source for generating a laser beam, said laser beam having a plurality of laser pulses, wherein each laser pulse has a first wavelength and a pulse duration less than approximately two hundred femtoseconds;

10 an optical assembly for focusing each laser pulse to a focal point in the fundus, with the focal point being characterized by a spot size having a diameter of approximately two microns;

a means for detecting a return light having a second wavelength, wherein the return light is generated when the laser beam is incident on anisotropic tissue in the fundus; and

15 a means for evaluating the return light to determine the health of the fundus tissue.

2. A system as recited in claim 1 wherein said first wavelength is in the range between 700 nm to 1000 nm, and further wherein said second wavelength is in the range between 350 nm to 500 nm.

20 3. A system as recited in claim 2 wherein said first wavelength is 880 nm.

4. A system as recited in claim 1 wherein a pulse of said laser beam has an energy level of 1nJ.

5. A system as recited in claim 1 wherein said optical assembly includes adaptive optics.

6. A system as recited in claim 5 wherein said optical assembly further comprises:

an active mirror;

5 a scanning unit for periodically moving said laser beam from one focal point to an adjacent focal point in the fundus, to focus said laser beam on a plurality of focal points within said fundus;

two focusing lenses;

a wavefront sensor for generating data indicative of an alignment of the eye; and

10 a computer for receiving the data from said wavefront sensor for use in controlling said active mirror to direct said laser beam to the focal point.

7. A system as recited in claim 1 wherein said laser beam irradiates a focal point with about five laser pulses.

15 8. A system as recited in claim 1 wherein said detecting means comprises an imaging unit in electronic communication with a computer.

9. A system as recited in claim 1 wherein said evaluating means uses a pattern of the return light to evaluate the health of the fundus tissue.

20 10. A system as recited in claim 1 wherein said evaluating means compares an intensity level of said return light to a predetermined threshold value of light intensity to evaluate the health of the fundus tissue.

11. A system as recited in claim 1 wherein the return light includes a plurality of responses, and further wherein said evaluating means counts the number of return light responses to evaluate the health of the fundus tissue.

12. A method for diagnostically evaluating the health of tissue within the fundus of an eye which comprises the steps of:

dilating the iris of the human eye to create an aperture having an extended diameter;

5 directing a laser beam through said aperture to a focal point in said fundus of said eye, said laser beam having a plurality of laser pulses, wherein each laser pulse has a first wavelength and a pulse duration less than approximately two hundred femtoseconds;

10 detecting a return light having a second wavelength, wherein said return light is generated when said laser beam is incident on anisotropic tissue in the fundus;

evaluating said return light to determine the health of the fundus tissue.

13. A method as recited in claim 12 wherein said extended diameter
15 is approximately six millimeters (6mm).

14. A method as recited in claim 12 wherein the energy level of said laser pulse is 1nJ.

15. A method as recited in claim 12 wherein said first wavelength is in the range between 700 nm to 1000 nm, and further wherein said second
20 wavelength is in the range between 350 nm to 500 nm.

16. A method as recited in claim 15 wherein said first wavelength is 880 nm.

17. A method as recited in claim 12 wherein said directing step further comprises the steps of:

programming an active mirror to compensate said laser beam;
reflecting said laser beam off said active mirror to direct said
5 laser beam through a scanning unit and at least two focusing lenses;
and

periodically moving said laser beam from one focal point to an
adjacent focal point in the fundus, to focus said laser beam on a
plurality of focal points within said fundus.

10 18. A method as recited in claim 17 which further comprises the
step of receiving data indicative of an alignment of the eye from a wavefront
sensor for programming said active mirror to direct said laser beam to the
focal point.

19. A method as recited in claim 12 wherein said laser beam
15 irradiates a focal point with about five laser pulses.

20. A method as recited in claim 12 wherein said evaluating step
further comprises the steps of:

identifying a pattern of said return light; and
evaluating said pattern to determine the health of the fundus
20 tissue.

21. A method as recited in claim 12 wherein said evaluating step
further comprises the steps of:

quantifying the intensity level of said return light; and
comparing said intensity level to predetermined threshold levels
25 of light intensity for determining the health of the fundus tissue.

22. A method as recited in claim 12 wherein said return light includes a plurality of responses, and further wherein said evaluating step further comprises the step of counting the number of return light responses for evaluating the health of the fundus tissue.

5 23. An apparatus for diagnostically evaluating the health of tissue within the fundus of an eye, which comprises:

 a laser source for generating a laser beam, said laser beam having a plurality of laser pulses, wherein each laser pulse has a first wavelength and a pulse duration less than approximately two hundred
10 femtoseconds;

 an optical assembly for focusing each laser pulse to a focal point in the fundus, said focal point being characterized by a spot size having a diameter of approximately two microns;

 an imaging unit for detecting a return light generated when said
15 laser beam is incident on anisotropic tissue in the fundus, wherein said return light has a second wavelength; and

 a computer for evaluating said return light to determine the health of said fundus tissue.

24. An apparatus as recited in claim 23 wherein said first
20 wavelength is in the range between 700 nm to 1000 nm, and further wherein said second wavelength is in the range between 350 nm to 500 nm.

25. An apparatus as recited in claim 23 wherein said first wavelength is 880 nm.

26. An apparatus as recited in claim 23 wherein said optical
25 assembly includes adaptive optics.

27. An apparatus as recited in claim 26 wherein said optical assembly further comprises:

an active mirror;

5 a scanning unit for periodically moving said laser beam from one focal point to an adjacent focal point in the fundus, to focus said laser beam on a plurality of focal points within said fundus;

two focusing lenses; and

10 a wavefront sensor for generating data indicative of an alignment of the eye for use in controlling said active mirror to direct said laser beam to the focal point.

28. An apparatus as recited in claim 23 wherein said laser beam irradiates a focal point with about five laser pulses.

29. An apparatus as recited in claim 23 wherein a pulse of said laser beam has an energy level of 1nJ.

15 30. An apparatus as recited in claim 23 which further comprises a means for evaluating a pattern of said return light to evaluate the health of the fundus tissue.

20 31. An apparatus as recited in claim 23 which further comprises a means for comparing an intensity level of said return light to predetermined threshold values of light intensity to evaluate the health of the fundus tissue.

32. An apparatus as recited in claim 23 wherein said return light includes a plurality of responses, and further wherein the apparatus includes a means for counting the number of return light responses to evaluate the health of the fundus tissue.